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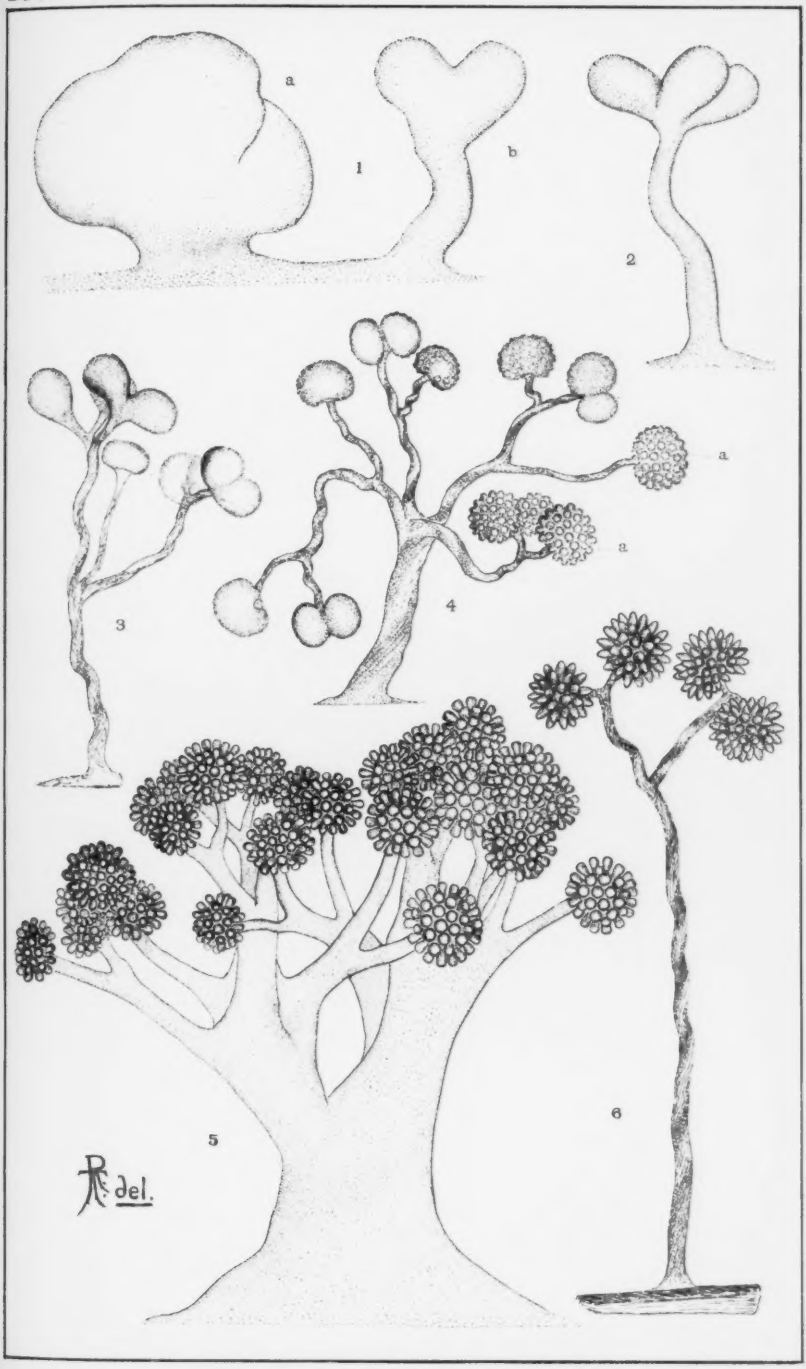
A comparative study of the roots of Ranunculaceæ, by FRED. B. MAXWELL, *University of Chicago.*

A method for obtaining pure cultures of Pammel's fungus of Texas root-rot of cotton, by DR. GEO. F. ATKINSON, *Cornell University, Ithaca, N. Y.*

A vacation in the Hawaiian Islands *will be concluded.*



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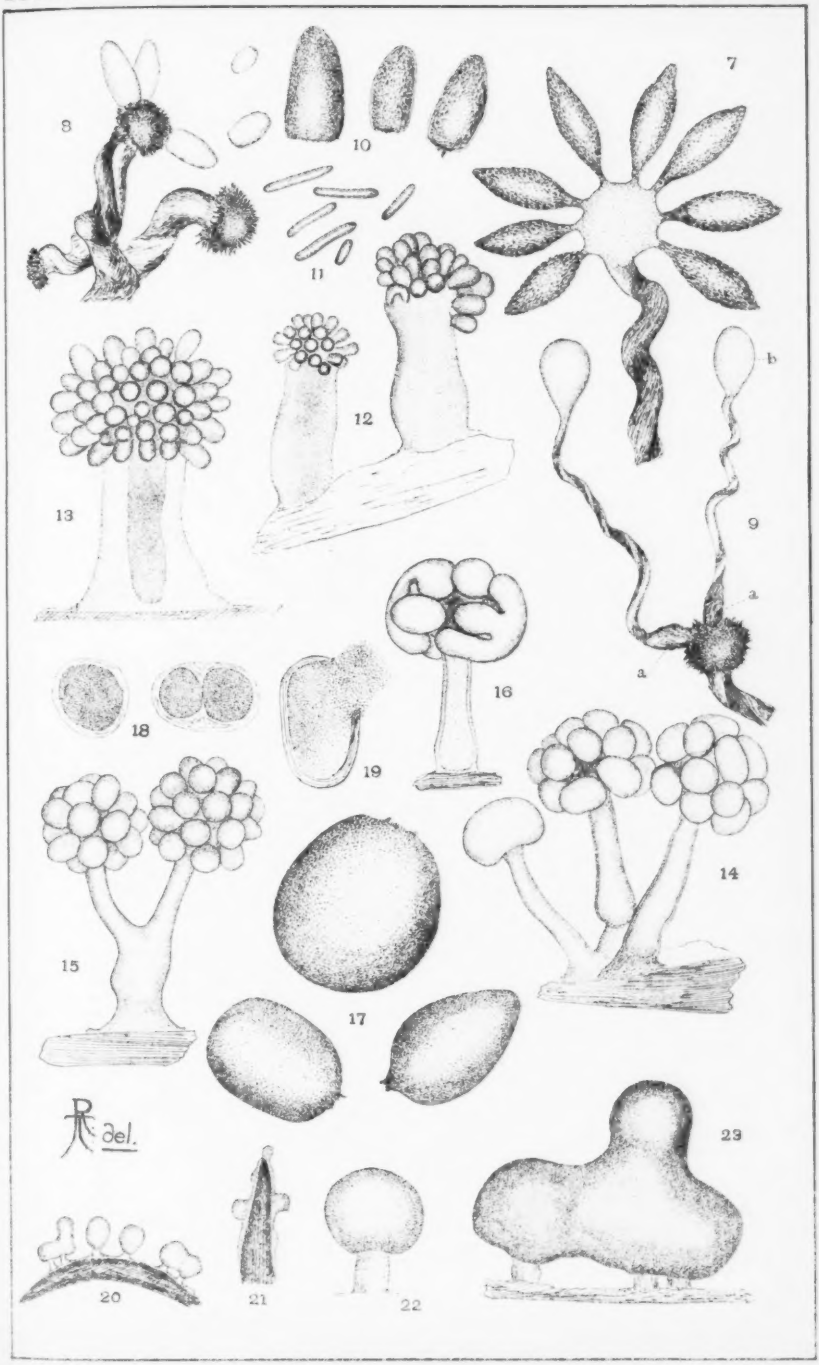

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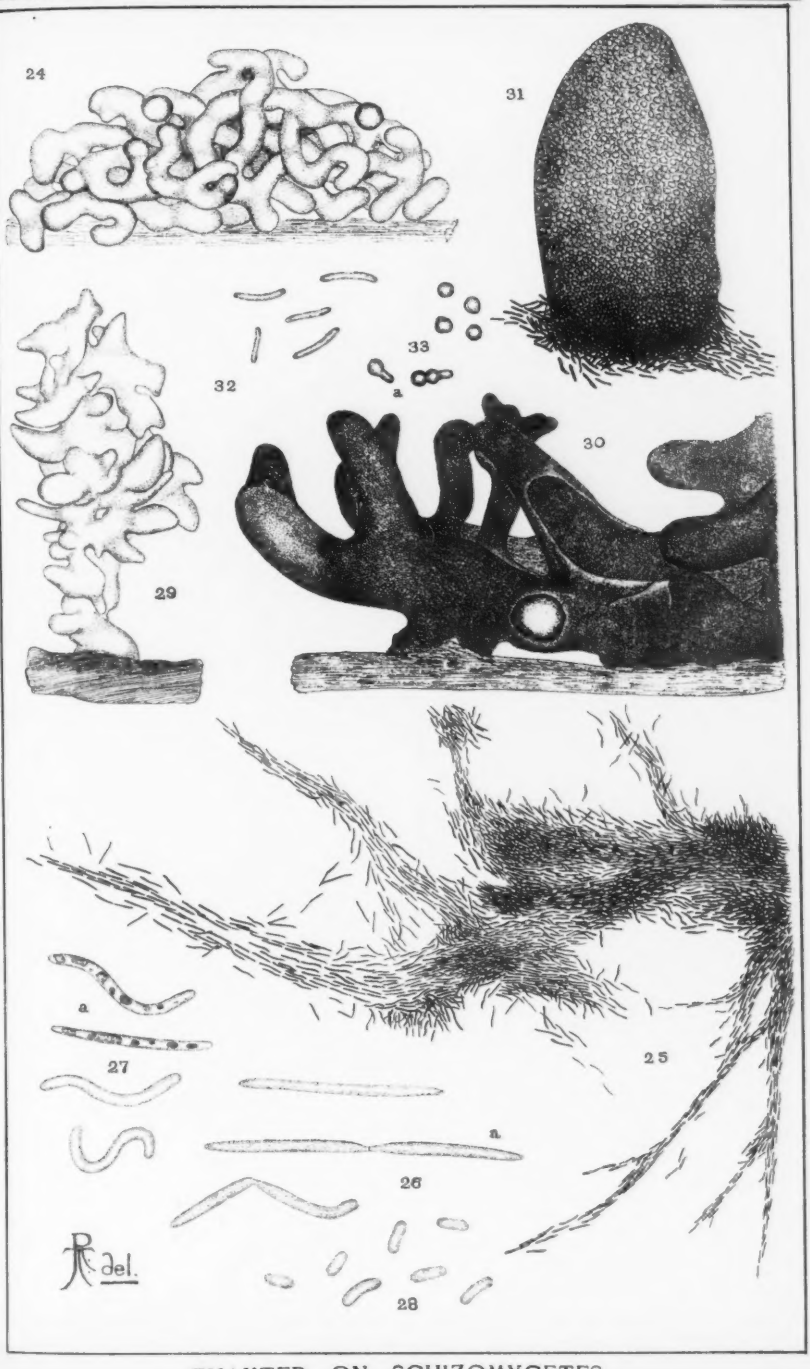

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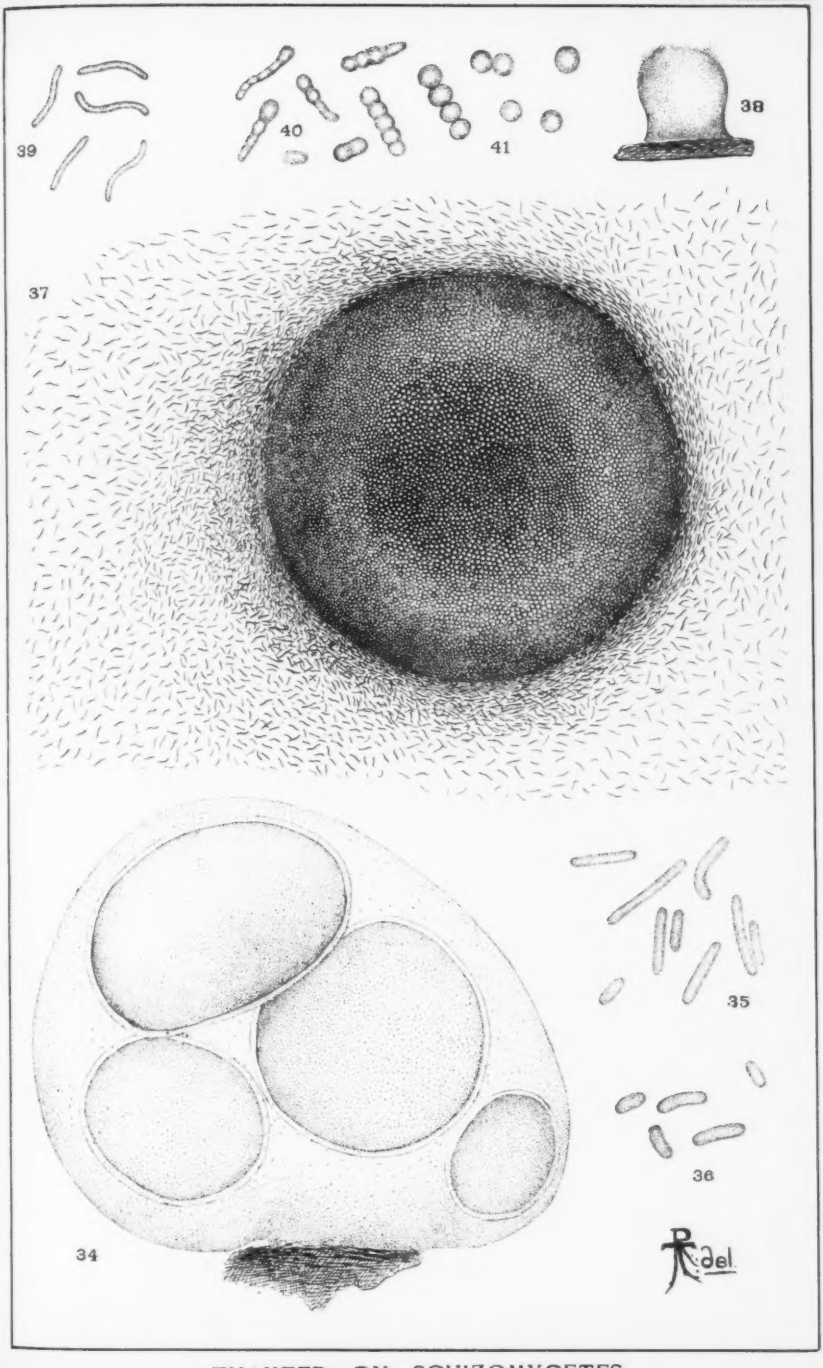

THAXTER ON SCHIZOMYCETES.

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BOTANICAL GAZETTE

DECEMBER, 1892.

Contributions from the Cryptogamic Laboratory of Harvard University. XVIII.

On the Myxobacteriaceæ, a new order of Schizomycetes.

ROLAND THAXTER.

(WITH PLATES XXII–XXV.)

A few years since, while collecting fungi at Kittery and in several other localities in New England and the southern states, the writer's attention was attracted by a bright orange-colored growth occurring upon decaying wood, fungi and similar substances, which, although in gross appearance it seemed somewhat highly organized, was found, when examined in a presumably mature condition, to consist of apparently amorphous material, without signs of hyphæ or spores of any kind. Its general appearance and the character of the substance which composed it suggested an immature condition of some myxomycete which had become dried while in the act of rising from the substratum to form its fructification, and on this supposition the material was laid aside until attention was again drawn to it by the occurrence on tree lichens in New Haven, of a closely related organism, which, when artificially cultivated, yielded immature conditions that rendered its true nature apparent. In addition to the two forms just mentioned, the writer has, during the past year, been fortunate in obtaining and cultivating several others having a similar life history, and it is upon these observations that the present paper is based.

This life history, which in several cases has been ascertained by the direct observation of pure cultures made upon sterilized media, is so peculiar, and corresponds so closely, despite the considerable differences which distinguish the more simple from the more highly differentiated forms, and is altogether so unique in the group of Schizomycetes, to which they should undoubtedly be referred, that their separ-

ation as a distinct order seems unavoidable. To the members of this order the writer proposes to give the name MYXOBACTERIACEÆ, for reasons which will become apparent if we consider for a moment the more important stages in their development.

It should first be noted that the life history of these organisms shows a distinct and more or less regular division into two periods; a period of vegetation and, under favorable conditions, a period of fructification or pseudo-fructification: but while the first period is essentially similar in all the forms observed, the second presents remarkable variations.

In the first instance a swarm or collection of rod-like bodies, derived from the successive division by fission of one or more primary individuals, always distinct from one another, possessing a power of slow locomotion and secreting as they multiply a firm gelatinous base which connects the colony as a whole, constitutes the vegetative condition of the organism. This vegetative state continues for a variable but distinct period of time, and in the different forms is characterized by slight variations in the grouping of the individuals composing it. In some cases these may be collected in radiating strands or concentric ridges, or again may be distributed evenly throughout the colony, which in all cases, when growing on a solid medium, possesses a clearly defined advancing edge or border, produced by a heaping up of active individuals in this position. The colony continues to extend itself in this fashion while the conditions remain favorable for its growth; but in the meantime the individuals within this advancing border, having increased rapidly by fission for a certain period, begin to swarm together at different points, often with a characteristic circular tendency in their motion. This piling up of individuals at definite points marks the beginning of the second period just mentioned, which has for its object the production of a resting state.

In the simpler forms, these masses, having raised themselves above the substratum in the form of papillate projections, become rounded off and may be directly encysted without further differentiation. A gelatinous envelope becomes hardened about them to form a protecting wall, within which the encysted individuals are capable of withstanding unfavorable conditions for a protracted period.

From such a simple type as that just described the forms

examined show various degrees of complexity, which reaches its maximum in a most remarkable organism, apparently identical with the supposed fungus described by Berkeley and Curtis under the name of *Chondromyces crocatus*. In this instance we have, following a period of purely vegetative activity, the same swarming together of individuals at different points in the colony; but the masses thus formed, instead of rounding themselves and becoming directly encysted, as in the previous instance, continue to rise vertically from the substratum into the air. The base of the rising mass becomes constricted; the constricted portion is gradually modified into a slender supporting stalk, formed partly of individuals left behind and partly from a gelatinous substance secreted by the mass as it rises. We have then a mass of individuals rising vertically on a slender stalk secreted from its base. This stalk may remain quite simple, or through the division of the mass into two or more lobes, may become successively several times branched, each lobe rising as a distinct mass on a secondary stalk of its own. Finally a condition is reached in which the stem or cystophore, as it may be conveniently called, is terminated by one or more rounded masses of very similar dimensions, in number corresponding to the ultimate divisions of the cystophore, and from these masses arise the cysts which perform the function of reproductive bodies. The cysts first appear as papillate projections covering the surface of each ultimate mass (fig. 4, *a*). The papillæ then become constricted at the base, as the rods composing the mass migrate into them, and assuming at first a fusiform shape, are finally converted in subconical cysts of very regular size and form. The cysts are caducous at maturity, falling from their attachment at the slightest touch, and are disseminated through the air like the conidia of many fungi, which they closely resemble. After a period of rest, and under favorable conditions, the rods make their exit simultaneously from the cyst, leaving behind an empty shell and enter at once upon a new vegetative period; or sometimes, while still *in situ*, proceed to form a secondary cyst (fig. 9, *b*).

Such are the extreme variations in the group, so far as concerns the differentiation of the cyst-producing generation. There appear to be, however, other important differences which divide the forms rather sharply in connection with the

modification of the individual rods at the period of encystment. For while in one group (Myxococcus), they become transformed into definite spores, in the other (Chondromyces and Myxobacter), the rods are encysted as such with little apparent modification, as far as the writer has been able to ascertain.

Without entering into further details of structure or development, which will be found below, sufficient has been said to make intelligible a brief comparison between the course of development of these plants and that of other organisms which may seem to possess certain characteristics in common with them.

The general character and structure of the rod-like individuals, together with their vegetative multiplication by fission, renders their schizomycetous nature as individuals a matter hardly to be doubted: but, on the other hand, the question may fairly be asked whether the remarkable phenomena which they present, not as individuals, but as aggregates, may not indicate a possible relationship in other directions. In the account just given it is hardly necessary to point out the evident similarity between the course of development described and that which occurs in the Mycetozoa, and more particularly in the Acrasieæ. In no other group, as far as the writer is aware, does there exist a similar concerted action of aggregates of individuals towards a definite end, namely, the production of a more or less highly differentiated resting state. Setting aside for the moment the fundamental differences presented by the cell characters in either group, the vegetative condition of the Acrasieæ and that of the Myxobacteriaceæ may be considered strictly comparable. In both cases multiplication by bipartition, followed by the complete separation as individuals of the two parts thus formed is followed in turn, after a period of successive bipartitions, by a swarming together of distinct individuals into aggregates of distinct individuals having a definite end in view. Apart from differences of cell structure, therefore, the essential characters of a pseudo-plasmodium are common to both groups.

Following the analogy to later stages of development a certain similarity may be noted between the steps which lead in either case from the simpler to the more complicated forms. In both instances a transition is observable from a mere heap-

ing together of individuals to form a resting state, to the production of a similar state, developed in a more complicated fashion and raised upon a highly differentiated stalk, through intervening forms, in which this stalk appears merely as a supporting base.

The most essential discrepancy which is apparent in such a comparison rests on the fundamental difference in cell structure already referred to, since although the Acrasieæ have taken a decided step away from the true Myxomycetes in the production of cells which neither coalesce nor produce pseudopodia (as in the Guttulinaceæ), the step from such amœboid cells to definite rods having all the characteristics of typical schizomycetous cells is, to say the least, a very long one. This fundamental difference necessarily involves equally important differences connected with the modification of individuals, in either case, while in the resting state, even when a definite spore formation takes place in both instances; while the encystment of numerous individuals to form a spore-like body, in the manner above described, presents an additional point of deviation in this connection.

In view of such important differences, the writer would hesitate to assume even a remote genetic connection between the two groups on a basis of resemblance which might well be purely accidental. Yet it is a question to which further investigation in this direction may afford a more definite answer, whether the evidence at hand may not show the necessity of still greater caution in accepting the views of those who would unceremoniously relegate the Mycetozoa to the domain of pure zoology: since, other matters apart, we find in the present order a characteristic at least very similar to that which has been held to constitute a crucial difference between the Mycetozoa and any known group of *plants*, namely, the occurrence in their developmental history of phenomena closely resembling those presented by plasmodia or pseudoplasmodia — not an indiscriminate heaping together of individuals as a result of merely vegetative processes, but a definitely recurring aggregation of individuals capable of concerted action towards a definite end, an end which finds its accomplishment in the production of a more or less highly developed resting state.

Whatever its true affinities may prove to be, however, the order is undeniably a very interesting and important one,

and although the present account is necessarily incomplete, it may serve to call attention to a subject which, beyond question, offers a productive field for further investigation.

Historically the story of the group is not a long one, yet is instructive in showing the absurdities to which the careless and wholesale description of new species may lead. *Chondromyces aurantiacus*, for example, has, if the writer's conclusions are correct, been placed in three separate genera of hyphomycetous fungi, although possessing no trace of hyphæ or of spores, the slight striation of the shrunken cystophore in the one case and the general external appearance of the cysts or of their contents in the other, having been made to assume these functions for descriptive purposes. The same is also true to a less degree of *C. crocatus*, although from its apparent rarity it seems to have escaped an extended synonymy. Whether any of the other forms enumerated below have been previously described the writer is unable to say; yet it seems very improbable that the spores of such common and conspicuous forms as *Myxococcus rubescens* and *M. virescens* should have escaped description, at least as chromogenous micrococci. The species of *Cystobacter* Schröter seem with little doubt to belong to the present family, and should probably be referred to *Chondromyces*, possibly *C. aurantiacus*, which in artificial cultivation produces a variety of abnormal forms and becomes "kastanien braun" when kept moist for a certain period. The descriptions of Schröter, however, are not sufficient to render any definite conclusion possible in the absence of proper figures.

MYXOBACTERIACEÆ.

Motile, rod-like organisms, multiplying by fission, secreting a gelatinous base, and forming pseudoplasmodium-like aggregations before passing into a more or less highly developed cyst-producing resting state, in which the rods may become encysted in groups without modification or may be converted into spore masses.

GENERAL CHARACTERS.— The vegative rods present but slight variations in size and form in the different genera and species. In all cases they are typically elongate, sometimes attaining a length of 15μ and, while living, show a tendency to taper slightly towards either extremity which disappears when they are killed, the ends becoming

bluntly rounded. The cell wall is highly elastic and surrounded by a barely perceptible gelatinous layer, while the cell contents may usually be seen to contain distinct granular masses (fig. 27, *a*) of irregular size and shape which stain more deeply than the remainder of the cell. Cell division follows an elongation and nearly median constriction of the rods which, except at the moment of division, are always separate, never united in chains. A slow, though distinctly visible movement characterizes the active rods and consists in a sliding locomotion in conjunction with a lateral bending. This lateral movement, which may take place in any plane, may be carried to such an extreme that the rod may form a loop with its ends approximated, after which the normal straight position may be assumed with considerable rapidity. This bending movement is doubtless an important factor in the sliding locomotion which though barely perceptible, can be definitely ascertained by careful watching.

The grouping of rods in a colony may vary somewhat in different species and under different conditions. In *Chondromyces aurantiacus*, for example, they may, when growing in a semi-liquid medium, show a tendency to radiate from a common center in rope-like, anastomosing strands, while on a solid medium these strands may form ridges, the alternate elevations and depressions in which may give the colony a characteristic corrugated appearance. In other cases, as for example in Myxococcus, the rods may show less tendency to collect together, remaining more or less evenly distributed until just before the period of spore formation. In all cases the individuals of a colony are heaped together in the region of its advancing margin which is distinctly elevated above its surroundings, and characteristically roughened by great numbers of partly free individuals projecting from its surface. In all species, with one exception, the rods when seen in masses, are more or less distinctly reddish. This color may, however, be lost as the mass rises to form cysts, as is the case in *C. crocatus* as well as in *Myxobacter aureus*.

A distinct, firm, hyaline, gelatinous base is secreted by the colony as it extends itself, over which the individuals may move or in which they may become imbedded, and is so coherent a structure that whole colonies may be stripped intact by means of it, from the surface of nutrient agar, for example. At the period of cyst formation it is often left

behind as a distinct shining membrane in which a few rods remain here and there imbedded.

The duration of the vegetative period varies according to circumstances. In artificial cultures it usually lasts about a week or even two weeks; but in nature the production of cysts must certainly be more rapid. In *Chondromyces lichenicolus*, for example, a period of moist weather following continued drought, and lasting not more than two or three days is sufficient to cover the previously dry tree trunks on which it vegetates with large patches of cysts.

The preparations for the production of cysts are apparent to the naked eye in artificial cultures of *C. crocatus*, for example, about a day before the cystophores begin to rise. In this condition the colony even in the neighborhood of its advancing edge, assumes a lumpy appearance owing to the aggregation of rods at various points. In forms like Myxococcus, in which the rods are somewhat scattered, the first preparation for spore production as seen under the microscope consists in the appearance of groups of rods moving with a circular tendency and forming whirlpools, so to speak, in which the more central individuals soon become converted into spores, the successive formation of which results in the production of the elevated spore masses characteristic of the various forms.

The formation of a cystophore where it occurs results from the basal constriction of a papillate mass of rods which projects from the surface of the colony. The mass of rods moving upwards on one another, continually leaves behind and below it an external layer at its base which has become slightly hardened by exposure to the air and is composed partly of the gelatinous matrix, partly of individuals which soon become indistinguishable in it. As the mass rises within and above this slightly hardened layer, the latter, while being constantly renewed above, becomes contracted below to form the cystophore. The cystophore may therefore be compared during its formation, to a glass funnel, the flaring portion of which is being constantly renewed from the outer surface of the mass of rods contained within and rising above it, while the tubular portion is being constantly lengthened by the contraction of the flaring portion at its base. As the freely moving individuals pass up out of the upper portion of this tube it is left behind as a gelatinous structure which becomes

indurated and solid, its strength being often further increased in slender forms by a decided spiral twist.

This primarily tubular character of the cystophore is well shown in specimens of *C. aurantiacus* when cultivated with very moist surroundings. In such cases even after the cystophore has attained its full height a central clearly differentiated column of active individuals may be seen moving up to the cysts which are in process of formation at its summit (fig. 13). In its development the cystophore shows all degrees of complexity from the short supporting base (which may be wholly absent) of *C. lichenicolus*, to the elongate form in *C. crocatus* which may produce branches of the fifth or even sixth order.

In considering the encysted condition of these organisms, two distinct categories are recognizable in connection with this state, one in which the individuals thus encysted show little or no modification from the rod-like vegetative state, the other in which they are converted into definite spores.

In the first instance the form of the cyst varies considerably presenting in the genus Chondromyces the series illustrated by *C. serpens*, *C. lichenicolus*, *C. aurantiacus* and *C. crocatus* (figs. 24, 23, 22, 15, 14 and 6) and may be further modified by a more or less complete fusion of adjacent cysts originally distinct (figs. 24, 23, 16). This fusion may result in the anastomosing coil characteristic of *C. serpens* or may consist in a mere lateral adherence of two neighboring cysts as in *C. crocatus*. The degree of encystment also shows considerable variation in the series just mentioned and reaches its highest development in *C. crocatus* in which the distinction between cyst wall and cyst contents is clearly marked. The cysts of Myxobacter present an additional peculiarity in that the very large thick walled cysts are themselves involved in a gelatinous matrix which dries in the form of a tough general envelope.

The substance of these cysts, composed partly of rods and partly of a firm and surprisingly coherent matrix, appears at maturity even when examined under a high power of the microscope, to be composed of stringy amorphous matter which is separated by crushing with the greatest difficulty. It is only by the closest examination and the use of staining agents that the presence of any definite bodies whatever within such cysts can be made out. Here and there the closely adhering

rods may be separated and isolated by crushing; and in this condition they show little modification from the vegetative state except that they are somewhat shorter and thicker. In a few cases rods have been observed within the cysts in stained preparations in which an apparent differentiation of the rod contents was observable. Whether this appearance was due to the presence of spores or merely indicated an accidental aggregation of the granular cell contents was not determined.

For a short time after the cysts are mature and also before they germinate after a period of rest, the contained rods are clearly defined and do not adhere closely to one another. The contents of such a cyst when crushed makes its exit as a mass of distinct rods somewhat shorter and thicker than the vegetative forms.

In "germination" the cysts emit their contents in a continuous stream which finally leaves the cyst wall as an empty shell, the emission being effected through the absorption of a portion of the cyst wall, usually at the base in the spore-like forms, sometimes at the apex or elsewhere. The mass of rods thus freed begins at once to vegetate, the individuals dividing rapidly and entering upon a new period of activity. Exceptions to this course are often found in old cultures of *C. crocatus* where cysts that have germinated *in situ* at the tips of the cystophores may frequently be seen producing secondary cysts directly, which are borne on short, slender secondary cystophores (fig. 9), a circumstance which still further illustrates the remarkable though superficial resemblances which exist between these forms and higher fungi.

In the sporiferous species, which have been included in the single genus Myxococcus, there may be a general encystment of the spore mass into a definitely formed coherent structure, as in *M. coralloides*, or this structure may normally become soft and semi-fluid through the deliquescence of the gelatinous matrix in which the spores are imbedded, as in *M. rubescens* and *M. virescens*. The spores are more or less irregularly spherical refractive bodies, the diameter of which is much greater than that of the rods from which they are derived, the difference being most remarkable in *M. rubescens* and *M. virescens*. The method by which the spores are derived from these rods has not been ascertained by continuous observation, since sporulation only takes place at the period when

the rods swarm together for this purpose and then only in the central region below the rising mass of spores which, together with the aggregation of rods around it, completely conceals the details of transformation when viewed directly under the microscope. By crushing such masses, however, the steps by which the spore-production is effected may be inferred from the occurrence, here and there in the swarm of unmodified rods and spores thus separated, of forms similar to those represented in fig. 40. Such forms would indicate that the rod, by division following simultaneous or successive enlargement throughout its whole length, is directly converted into spores varying in number according to the length of the rod; and in the absence of any indication of a different process this may be assumed to be correct. This conclusion is further supported by the very frequent occurrence in such preparations of chains of spores adhering in twos, threes or even fives (fig. 41).

The germination of these spores has not been observed to the writer's satisfaction; but appears to consist in a gradual transformation from the round to the rod-like form. Whether an external membrane is left behind in this process could not be determined.

The nine species which constitute the family so far as at present known, may be arranged under three genera, as follows:[1]

CHONDROMYCES B. & C. (1857), in Berk. Introd. Crypt. Bot., p. 313, fig. 70, a (no descr.) 1857. do. in Grevillea III. p. 64 (first descr.) 1874.

Stigmatella: B. & C. in Berk. Introd. Crypt. Bot., p. 313, fig. 70, b (no descr.) 1857. do. in Grevillea III, p. 97 (first descr.)

? *Polycephalum:* Kalch. & Cke. in Grevillea IX, p. 22, 1880.

? *Cystobacter:* Schroeter in Kryptogamen-fl. v. Schlesien III, 1, p. 170.

[1] NOTE.— In considering these forms from a systematic point of view the writer has preferred to avoid the multiplication of genera and species; since the true value of generic and specific distinctions in a group so little known in these respects, is a matter which can only be settled satisfactorily by a wider knowledge of the remaining forms, which undoubtedly exist. For this reason it has not been thought advisable to separate generically members of the series included under Chondromyces, the connection between the extreme forms (*C. crocatus* and *C. serpens*) being so well illustrated by the remaining species. Again, the deliquescent guttulae which constitute the spore masses of *Myxococcus rubescens* and *M. virescens* and the definitely coherent structure found in *M. coralloides* are very different in character, yet in the absence of further data as to species a generic discrimination of these forms seems inadvisable. The writer recognizes the fact, however, that further information may modify the arrangement adopted not only in regard to genera and species, but also in connection with the division of the groups as a whole, which might properly be divided into two definite sub-families based upon the peculiarities of the resting condition.

Rods forming free cysts, in which they remain unmodified. Cysts various, sessile or borne on a more or less highly developed cystophore.

CHONDROMYCES CROCATUS B. & C. Plates XXII, XXIII, figs. 1–11.

Chondromyces crocatus: B. & C. in Berk. Introd. Crypt. Bot. p. 313, fig. 70, a (no descr.) Berkeley in Grevillea, III, p. 64 (descr.) Cooke in Bull. Buff. Soc. Nat. Sci. III, p. 192. Saccardo, Sylloge Fungorum IV, p. 576.

Aspergillus crocatus: B. & C. in herb. Curtis, and herb. Berkeley (*sec.* Farlow).

Colonies pale orange red. Rods cylindrical or tapering slightly straight or slightly curved, 2.5–6× .6–.7μ. Cystophore orange colored, slender, simple or 1–5 times successively branched, striate, spirally twisted or irregularly bent; average height 600μ, rarely 1 mm. Cysts pale straw colored, at first fusiform, at maturity sub-conical, rounded at the apex, often ragged at the base. Average dimensions 28×12μ (15–45×6–20μ), in variable numbers at the tips of the cystophore where they form globose heads, 70–90μ in diameter.

South Carolina, *Ravenel*, in herb. Curtis and herb. Berkeley, on decaying melon rind. Cambridge Mass., on old straw.

The specimens of this plant in the Curtis collection correspond in all respects with the Cambridge material which made its appearance on some old straw sent from Ceylon, and has been kept in cultivation in the laboratory, growing readily on nutrient agar and luxuriantly on sterilized horse dung. According as the substratum is moist or dry the general habit may vary considerably, excessive moisture often producing considerable irregularity in the form and number of the cysts as well as in the cystophore, which is thicker under these conditions, more irregularly branched and without the spiral or longitudinal striations (due to wrinkles of the surface) usually characteristic of the slender forms.

Cultures of the cysts in Van Tieghem cells have yielded few germinations after several months, but it may be readily observed by placing in a moist chamber a specimen which has been kept dry. By examining such a specimen after one or two days the germinating cysts may be seen in all conditions. At first the contents becomes slightly contracted within the cyst-wall and in it the separate rods may be distinctly seen; then through the absorption of the wall usually at its base, the rods are allowed to make their escape in a continuous stream till nothing but the empty cyst-wall is left behind.

The mature cysts show none of the reddish coloring pecu-

liar to the other species, and as in *Myxobacter aureus* this seems to be lost as the rod-masses rise to produce cysts. Although so conspicuous a form, this species does not appear to have been recorded since its discovery by Ravenel, Cooke and Saccardo merely quoting Berkeley's publication in the references above cited. As a matter of curiosity Berkeley's description is appended.

"*Chondromyces* B. & C. Stipes e floccis compactus ramosus induratus, sporæ apicales.—600. *Chondromyces crocatus* B. & C. On decayed melons. Car. Inf. no. 1335. Stem closely compacted, orange, subcartilaginous, branched, the branches more or less divaricate, nodular at the apex; spores elongate-ovate with a very short pedicel." Grev., *l. c.*

CHONDROMYCES AURANTIACUS (B. & C.)—Plates XXIII, XXIV, figs. 12–19 and 25–28.

Stigmatella aurantiaca: B. & C., in Berk. Intr. Crypt. Bot., p. 313, fig. 70, b. do. Grevillea, vol. III, p. 97. Cooke, Bull. Buff. Soc. Nat. Sci., vol. III, p. 193. Curtis' Cat., p. 126. Saccardo Sylloge Fung., IV, p. 680.

? *Polycephalum aurantiacum:* Kalchbr. & Cke. Grevillea IX, p. 23, pl. 135, fig. 10, a, b, c. (1880). Saccardo Sylloge Fung. IV, p. 576.

? *Stilbum rhytidospora:* Berk. & Broome, on the Fungi of Ceylon, Jour. Linn. Soc. (Botany) XIV, p. 96, plate IV, fig. 16 (1873). Sacc. Sylloge IV, p. 571.

Colonies flesh colored, distinctly reddish. Rods large, tapering somewhat, normally straight, rounded at either extremity 7–15×.6–1μ, average 7×.5μ. Cystophore hyaline or flesh-colored, stout, straight, simple or rarely furcate. Average height 200μ. Cysts at first stalked, then sessile, oval to elliptical or rounded in outline, often irregular in size and shape, bright orange colored when dry, becoming chestnut brown when kept moist for a considerable period, borne in variable numbers and forming globose heads at the extremity of the cystophore. Cysts about 30–50×30–75μ.

S. Carolina, on *Sphæria Hibisci* (herb. Curtis). N. Carolina, Connecticut to Maine, on decaying wood and fungi.

With the exception of *Myxococcus rubescens* this is the commonest member of the group and must have been met with by any one who has sought for Myxomycetes on decaying wood, where though very minute it is conspicuous from its bright color. Although easily cultivated on nutrient agar, unlike *C. crocatus* it rarely produces well formed cystophores and cysts on this medium, though cultivable on its ordinary substrata without difficulty.

In giving its synonymy, *Polycephalum aurantiacum* K. & Ck. as well as *Stilbum rhytidospora* B. & Br. have been included

with a query. The description and figures given in either case leave little doubt of the correctness of this reference, but a comparison of authentic specimens has not been made. Whether one or both of the forms described by Schroeter under Cystobacter may not prove abnormal conditions of this species is also uncertain; but on very moist media it shows conditions closely resembling his descriptions, and becomes chestnut brown after continued exposure to moisture, thus presenting an additional point of resemblance. Even in its natural substratum cyst formation is subject to great irregularities, especially if the rising rod masses become slightly dry during the process. In such cases the latter may heap themselves together in irregular cyst masses lying directly upon the substratum with little or no differentiation of a cystophore.

The genus Stigmatella, which was founded upon this species, is made by Saccardo to include two species, *S. aurantiaca* and *S. pubescens* Sacc. & Ell., the latter having been formerly described under the name *Sphærocreas pubescens* Sacc. & Ell. (Michelia II, p. 582.) Although Saccardo remarks concerning this form, "De identitate *Sphærocreatis* cum *Stigmatella* nullum mihi est dubium," it is difficult to see on what this opinion is based; the fungus in question consisting of a rounded mass of large chlamydospores borne terminally on well defined hyphæ and surrounded by a woolly mass of somewhat differentiated hyphæ. It is needless to remark that the two can have no connection, Sphærocreas being clearly a fungus allied to if not generically identical with forms included in the genus *Endogone*.

Chondromyces lichenicolus n. sp.—Plate XXIII, figs. 20–23.—Colonies reddish, rods cylindrical, tapering slightly, 5–7 × .6μ. Cystophore simple, short, squarish, often absent or ill developed, 7–8 × 10μ. Cysts single, rounded or irregularly lobed, often confluent, bright red, 35 × 28μ.

Parasitic on living lichens, which it destroys, New Haven, Ct.

This species has not been met with in any locality other than the one mentioned, where it occurs abundantly on the trunks of the elms and maples along the city avenues, often covering patches several feet in length. The cysts are very irregular in form, often lobulated and laterally confluent, and their crowded habit and deep red color make them very conspicuous. Owing to the shortness of the cystophore, it is seen

with difficulty *in situ*, and seems often to be wholly absent. Specimens kept dry in the herbarium for eighteen months germinate readily when sown on moist lichens, and like other cysts of the group would probably retain their vitality for a much longer period.

Chondromyces serpens n. sp.—Plate XXIV, fig. 24.—Rods as in *C. lichenicólus*. Cysts flesh-colored, dark red when dry, 50μ in diameter, confluent in an anastomosing coil. Cystophore absent.

On decaying lichens, Cambridge, Mass.

This species made its appearance in company with *C. lichenicolus* in a laboratory culture and was at first taken for an abnormal condition of that species. Cultures on agar and on lichens, however, constantly produced the same convoluted form which seems to be quite distinct and differs from all the remaining species of the genus in possessing no cystophore, the mass being sessile upon its substratum, and often reaching a length of more than a millimeter.

MYXOBACTER n. gen.—Rods forming large rounded cysts, one or more free within a gelatinous matrix raised above the substratum.

Myxobacter aureus n. sp.—Plate XXV, figs. 34–36.—Colonies when rising to form cysts milky white. Rods large, cylindrical, rounded at either end, 4—7×.7—.9μ. Cysts spherical or oblong, golden yellow, thick walled, one to twelve or more in number, distinct within a hyaline matrix, 75—350×75—275μ. The encysted rods mingled with a yellow, oily material. Cyst groups .7—1mm. long.

On very wet wood and bark in swamps. Kittery Point, Me., Belmont, Mass.

MYXOCOCCUS n. gen.—Rods slender, curved, swarming together after a vegetative period to form definite, more or less encysted sessile masses of coccus-like spores.

Myxococcus rubescens n. sp.—Plate XXV, figs. 37–41.—Rod-masses reddish, rods slender, irregularly curved, 3—7×.4μ. Spore masses scattered, drop-like, flesh-colored to dull orange, deep crimson when dry, at first coherent, becoming deliquescent, 150μ—1mm. in diameter, often confluent. Spores round, 1.5—1.2μ in diameter.

On various decaying substances, lichens, paper, dung, etc. This species is so common and makes its appearance with

such constancy on laboratory cultures of horse dung that it seems hardly possible it should have escaped previous description as a chromogenous coccus. The only form which has been described on this substratum to which it could possibly be referred is *Micrococcus fulvus* Cohn[1]. This species appears however, to be a true Micrococcus and, judging from the specimen in Rabh. Alg. Eu. no. 2501, bears little resemblance to the present form. The drop-like masses are at first more or less coherent and may be transferred intact to a slide for examination; but they soon become deliquescent, adjacent guttulæ coalescing into viscous masses more than a millimeter in diameter. The variation from flesh-color to orange-red forms may indicate an additional species, the orange type retaining this tint in agar cultures without varying towards the flesh-colored form. The morphological differences if there are any, are, however, too slight to warrant a specific distinction.

Myxococcus virescens n. sp.—Rod masses greenish yellow. Rods as in M. rubescens. Spore masses clear yellow-green to green, 150–500μ in diam. Spores round, 1.8–2μ in diam.

On hen's and dog's dung, New England.

This species, which closely resembles the last except in color, is rather rarely met with on the substrata mentioned, forming rather smaller spore masses. When cultivated on potato agar it tends to lose its green color and become yellowish. The spores seem constantly larger than in the preceding species.

Myxococcus coralloides n. sp.—Plate XXIV, figs. 29–33.—Rod masses pale pinkish, thin. Rods slender, curved, 4—7 × .4μ. Spore mass firmly coherent, erect, variously branched or lobed, the lobes or branches usually tapering towards the rounded apex, flesh-colored, becoming bright pinkish when dry; maximum height 350μ, the lobes about 20–30μ in diameter. Spores spherical, 1–1.2μ in diam.

On decaying lichens, Cambridge, Mass.

This striking form made its appearance in laboratory cultures and was readily cultivated on lichens and potato agar. The coral-like form of the spore mass is very variable, presenting every imaginable variation from a simple papilla to a complicated structure similar to that represented in fig. 29.

In addition to the species above enumerated the writer has observed several others, among them a very minute and peculiar

[1]Cohn: Beitr. z. Biol. d. Pflan. 1, 3, p. 181.

form occurring on rabbit's dung, belonging to the Myxobacter group, and another on lichens near *Myxococcus coralloides*, but was unable at the time to observe any of them under cultivation. Further additions to the order are therefore certainly to be looked for.

Cryptogamic Laboratory of Harvard University.

NOTE.— **Myxobacter simplex** n. sp., for which I accidentally omitted to send manuscript will be characterized in the succeeding number.

EXPLANATION OF PLATES XXII–XXV

The figures are drawn with few exceptions from specimens mounted in glycerine. The combinations used are as follows: Figs. 1–6, 12–16, 20–21, 24, 29, 34: Zeiss oc. 4, obj. A. Figs. 7–10, 17–19, 22–23: Zeiss ocul. 4, obj. D. Figs. 11, 26–28, 31–33, 35–36, 39–41: Zeiss comp. oc. 12, Leitz oil im. $\frac{1}{12}$. Fig. 31: Zeiss oc. 4, Leitz oil im. $\frac{1}{12}$. All figures reduced $\frac{1}{4}$ by photo-lithography.

PLATE XXII.

Chondromyces crocatus (B. & C.)

Fig. 1–6 successive conditions of cyst formation shown by as many individual specimens. Fig. 1. *a*, mass of rods just rising from substratum and becoming constructed at its base. *b*, smaller mass which has begun to secrete a cystophore and has become two-lobed preparatory to branching. Fig. 2. A more advanced specimen, the mass preparing to produce three branches. Figs. 3, 4. Nearly mature cystophores showing branching of the third and fourth order, the ultimate masses beginning in some instances (*a*, *a*) to bud out into cysts. Fig. 5. Specimen cultivated on moist agar, the cystophore unusually stout, the ultimate masses almost wholly converted into immature cysts. Fig. 6. Specimen grown on straw showing normal habit; the cysts not yet mature.

PLATE XXIII.

Chondromyces crocatus (B & C.)

Fig. 7. Optical section of ultimate rod mass from which the rods have for the most part migrated into the immature cysts. Fig. 8. Three ultimate branches of a cystophore, one of them with three mature cysts still *in situ*. Fig 9. Tip of an ultimate branch of a cystophore on which two cysts still *in situ* have germinated to produce secondary cystophores and cysts (*a*, *a*). Fig. 10. Five detached mature cysts showing extremes of size under ordinary conditions. Fig. 11. Vegetative rods.

Chondromyces aurantiacus (B. & C.)

Fig. 12. Young cysts budding from apex of cystophore. (Living material.) Fig. 13. A more advanced stage, a central column of ascending rods surrounded by a gelatinous layer. (Living material.) Fig. 14. Three specimens from dried material one showing terminal rod-mass from which the cysts have not yet begun to bud. Fig. 15. Specimen from dried material showing furcate habit. Fig. 16. Mature specimen from dry material in which the cysts show lateral coalescence. Fig. 17. Three mature cysts. Fig. 18. Two cysts kept on moist wood for several weeks, preparing to germinate. Fig. 19. A similar cyst germinating.

Chondromyces lichenicolus n. sp.

Fig. 20. Mature cysts on short cystophores. Fig. 21. Rod masses rising to form cysts. Figs. 22–23. Mature cysts with short cystophores, showing lobulation and coalescence.

PLATE XXIV.

Chondromyces serpens n. sp.

Fig 24. General habit of coalescent cysts.

Chondromyces aurantiacus (B. & C.)

Fig. 25. General appearence of a portion of rod mass growing in fluid agar. Fig. 26. Living rods from active rod-mass. *a*, rod dividing. Fig. 27. Vegetative rods in glycerine (*a*) showing granular contents stained with borax carmin. Fig. 28. Rods isolated in mature crushed cysts.

Myxococcus coralloides n. sp.

Fig. 29. Highly developed spore mass. Fig. 30. Spore mass of a different form more highly magnified. Fig. 31. Spore mass rising from rod mass at its base. Fig. 32. Vegetative rods. Fig. 33. Mature spores. *a*, spores in process of formation.

PLATE XXV.

Myxobacter aureus n. sp.

Fig. 34. General habit showing four cysts embedded in gelatinous matrix. Fig. 35. Rods (living) from rising rod-mass. Fig. 36. Rods from cysts crushed at maturity.

Myxococcus rubescens n. sp.

Fig. 37. General appearance of young spore mass viewed from above and surrounded by vegetative rods. Fig. 38. Normal habit of spore mass viewed laterally. Deliquescence beginning at the top. Fig. 39. Vegetative rods. Fig. 40. Different stages of supposed spore formation. Fig. 41. Mature spores.

Development of the flower and embryo-sac iu Aster and Solidago.

G. W. MARTIN.

(WITH PLATES XIX AND XX.)

Concluded from page 358.

Let us now turn to the development of the ovule and the embryo-sac. A short time before the floral organs attain their maximum length, there appears at the bottom of the ovarian cavity a rounded excrescence; this is the incipient ovule, the promise of a future seed (fig. 11).[6] This incipient ovule does not arise from the bottom of the ovarian cavity, but a little above the lowest point. Therefore, the ovule is not the terminal structure on the floral axis. For, by careful focusing, the apex of the fascicular system is seen to end very abruptly at the bottom of the ovary cell. To the right and left of the axial bundle of the pedicel, a little below the apex, are given off fibro-vascular bundles which traverse both sides of the carpellary leaf. It is in the region of one of these lateral bundles, beneath the epidermis, that the primitive cells develop, which arch upward and give rise to the funiculus and the nuclear ovule. Subsequently, a branch of this lateral bundle

[6] The ovule somewhat advanced.

enters the funiculus. According to the investigations of Sachs and others, made upon the Compositæ, we have the assertion that the nuclear ovule is a lateral out-growth of the funiculus, but this statement could not satisfactorily be verified by my study of the two genera under investigation. As to the question whether the ovule is a lateral outgrowth on the flower axis there can be no doubt.

So far as could be determined no trace of evidence showed the ovule to be a direct outgrowth on the axis, but on the other hand, an outgrowth on the leaf. Returning again to the early growth of the ovule, as before stated, that it first appears as a rounded excrescence surmounting the funiculus. At first the ovule consists of a mass of cells, the tissue of which is soft and cellular, and is designated the nucleus of the ovule or the nucellus. By further development a large nucleated cell appears within this nucellar tissue, which soon divides, the apical cell of which becomes the mother-cell of the embryo-sac (fig. 12a). In its early development the nucellar body is almost orthotropous, but by further growth it becomes curved (caused by a stronger growth on one side) at the point (base of the nucellus, where the integument originates (fig. 12 b)[7]. At first the integument appears as an annular ring; as growth takes place it forms a complete wall around the nucellus; as the wall encroaches upon the apical portion of the nucellus, the latter becomes more and more curved, but does not seem to be wholly inverted till the integument completely surmounts it, even passing far beyond the nucellar apex (fig. 16). Thus, we have an ovule which is anatropous; having a single integument, though very thick and forming the greater mass of the ovule before fertilization is accomplished, investing a small central portion, the nucellus (fig. 13a)[8]; and the latter, which consists of but one layer of cells, in turn surrounds a more central portion, the embryo-sac (fig. 13b). Originally, this sac consists of but a single nucleated-cell, which, when division is complete, forms a central row of four cells (fig. 16). The nucellus in process of growth becomes very much elongated; its cells are well defined and nucleated; likewise the mother-cell of the embryo-sac, though primitive-

[7] Advanced stages of the ovule.

[8] At this point it may be stated that the integument does not develop on the side next the funiculus; this is common with anatropous ovules.

ly polyhedral in outline, but later more oval in contour, elongates and contains a nucleus with nucleolus imbedded in a rich mass of protoplasm. In some sections the nucleus appeared to be elongated in the same direction as that of the embryo-sac. During the subsequent growth of the integument and nucellus the embryonal sac enlarges (figs. 13 and 14), and the nucleus of the mother-cell undergoes subdivision. In fig. 15 the nucleus has divided, and the mother-cell is now separated into two equal parts by a transverse wall, each part containing a nucleated-cell. Presently, the two nuclei divide, a transverse wall is formed in each half, and thus we have, at the end of the second and last subdivision of the mother-cell of the embryo-sac, four equal nucleated-cells (fig. 16). At this stage of the embryo-sac there is a very close analogy to the division of the mother-cell into four cells, worked out by Strasburger in Polygonum and Senecio. The cross walls formed between the cells are very strongly refractive and much swollen; the middle transverse wall is remarkably distended and persists much longer than the other two partitions; in several sections the middle wall was found intact when the coutents of the cells were completely absorbed.

Of the four cells into which the primitive mother-cell of the embryonal sac is now divided, only the lower one is characterized by further growth;[9] this cell, therefore, becomes the true mother-cell of the embryo-sac (fig. 17, *a*). Subsequently, the protoplasm of the upper three cells becomes viscid, the nuclei show disintegration, and the upper wall of the lower, club-shaped cell (mother-cell) indicates a rigid turgescence. When the upper three cells begin to disorganize (in centrifugal order), they become crescent-shaped; their nuclei disappear, their walls are displaced, and the cell contents are absorbed by the encroachment of the lower, mother-cell. After the cells are completely disorganized and absorbed, the mother-cell assumes a central position in the embryo-sac (fig. 18). Simultaneously with the obliteration of the upper cells of the embryo-sac, the one-cell-layer of the nucellus undergoes a similar process of disintegration. The first mark of displacement is shown by the reduction of the cell contents to a granular protoplasmic mass; then follows the disappearance

[9] The micropylar end is known as the upper extremity of the ovule, while its opposite is the lower end.

of the transverse cell walls (fig. 18). The order of nucellar displacement begins at the apical end of the nucellus and proceeds toward its basal portion (fig. 19); finally, the whole nucellar-tissue is displaced and absorbed by the embryo-sac, which subsequently becomes very much enlarged. In fig. 19 is seen a partial obliteration of the nucellus and at this period of growtn the embryo-sac is completely filled with protoplasm, in the central portion of which is located the mother-cell with a vacuole both above and below it. Fig. 20 shows a complete displacement of the nucellus and elongation of the embryo-sac; a farther separation of the vacuoles; the first division of the mother-cell into two daughter cells, each moving, the one into the upper, the other into the lower end of the embryo-sac. In the next stage of development we have the first division of the polar nuclei, thus making two nuclei in each end of the embryo-sac. The two upper nuclei rest within an accumulation of protoplasmic substance, while the two lower nuclei rest within a less dense plasma between an upper and a lower vacuole which show a longitudinal expansion (fig. 21). Previous to the last division of the polar nuclei, a longitudinal increase of the whole embryo-sac takes place. Subsequently, each of the two nuclei divide and we have four nuclei occupying opposite extremities of the embryo-sac. Thus, division is complete, and the upper cells give rise to the egg-apparatus, while the lower are designated antipodal cells. The next stage of development, as in fig. 22, is characterized by the ascent of one of the antipodal cells toward the center of the embryo-sac. This nucleus is imbedded in a dense mass of protoplasmic material separating two large vacuoles. Of the three antipodal cells remaining, the two upper, which lie alongside and impinge on each other, also rest in a plasma bridge separating two vacuoles, the upper of which is the larger and the lower one of the two previously mentioned. The lowermost cell is partly obscured by the impingement of the lowermost vacuole. At the micropylar end of the embryo-sac the cells have a far different significance; one of the cells in its descent toward the center of the sac meets its fellow from below and both coalesce, thus forming a secondary or endosperm nucleus. The three remaining cells, though naked like the three opposite, but surrounded by a denser mass of protoplasm, constitute the true egg-apparatus. The two upper

cells of the egg-apparatus, which lie side by side occupying the whole tapering anterior end of the embryo-sac, are the synergidae; at their lower extremity, extending nearly across the sac, lies a larger rounded cell, the oosphere. In further development, as found in fig. 23, the embryo-sac becomes very much swollen, which is a characteristic feature both before and after the process of fertilization. But fertilization in this case has not yet been accomplished, as the perfectness of outline of the synergidae amply testify. The upper vacuole of the preceding figure shows a contraction toward the upper extremity of the embryonal sac and is more oval in outline. At this stage, also, the upper polar nucleus exhibits retarded action in its descent toward its counterpart from below, in many cases refusing descent till after or about the fertilization period.

To trace the embryonal sac in its further development would result in recounting what, already, is very familiar to many botanists.

Summary.—I. The calyx appears second in order of succession of the floral whorls.

II. The syngenesious anthers seem to be united structurally.

III. The upper polar nucleus shows a slow descent in uniting with the lower one to form the endosperm nucleus.

IV. Compared with Strasburger's study of Senecio the following differences were observed:

(1) The antipodal cells occur in no regular order, and as far as my investigations went, were never found arranged in a single longitudinal row.

(2) No more than four antipodal cells could be discovered, always naked and having no cross walls.

(3) The oosphere, as far as could be determined, failed to occupy the whole diameter of the embryo-sac.

(4) The nuclei of the cells composing the egg-apparatus seemed always to occupy an almost central position.

(5) Vacuoles were seldom seen in the synergidae.

All figures illustrating the development of parts given are from sections supposed to pass through the center of the tissue which they represent.

All material used was fixed in 1 per cent. chromic acid 24 hours, thoroughly washed, stained *in toto* with alum carmine 24 hours, again washed and dehydrated; then taken through

the xylol-absolute-alcohol process into a saturated solution of xylol and paraffine, then infiltrated with paraffine, imbedded, and sectioned with a microtome; again, the sections were counter-stained on the slide with Bismarck brown and mounted in xylol-balsam.

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Indianapolis High School.

A vacation in the Hawaiian islands.

DOUGLAS HOUGHTON CAMPBELL.

As the vacation approached, the question arose, "Where shall I go for the summer?" With the numerous interesting regions within comparatively easy reach of San Francisco, this question was not to be answered without some deliberation; but finally the Hawaiian islands were decided upon, as promising much of interest, both botanical and otherwise.

Hillebrand's Flora of the Hawaiian islands was procured; from it I obtained some idea of what might be expected in the way of vegetation, and with much interest I looked forward to the moment when, for the first time, I should find myself roaming in a tropical forest.

On the 6th of July, behold me, then, a passenger on the Australia, bound for Honolulu. There is very little to record of the voyage, which was pleasant enough but not eventful. One is struck by the paucity of life in the Pacific after getting away from the immediate vicinity of land. None of the giant kelps, so characteristic of the coast region, were seen after the first day out, nor was any floating sea-weed observed during the trip. Animal life was confined to a few sea-birds, mostly "gonies," small brown albatrosses, which followed the ship for several days. As the warmer waters were reached, flying fish became abundant, but they were pretty much the only animals noted on the way over. Not a vessel of any kind was seen after the first day, and the vast stretch of blue water was unbroken by any sign of life. The water is enormously deep, and of a blue so vivid, that one can almost believe that a handkerchief dipped into it would come out blue.

On awakening upon the seventh day out, and looking through the port-hole of my state room, I saw that we were sailing near land. Rugged barren looking hills were seen; and, going upon deck, I learned that this was Oahu, the island upon which Honolulu is situated. As we skirted the shore at a distance, I soon spied a grove of unmistakable cocoa palms, the first hint of the tropical vegetation to which I was soon to be introduced. Beyond was the bold promontory of Diamond Head, an extinct volcanic crater, forming a great bowl with rugged sides, right at the water's edge. Beyond this, and bounded partly by it, is the bay upon whose shores stands the city. Back of it rose abruptly a chain of mountains, in places about three thousand feet above sea-level, and furrowed by deep valleys, whose walls, as well as the cloud-capped summits of the hills, were covered with the most wonderfully verdant vegetation. Never before had I realized the possibilities of green. Blue greens, yellow greens, gray greens, and positive greens, with all degrees of these and others that are indescribable, combined to form what Whistler would term a symphony in green.

As if to vie with the colors of the mountains, the sea exhibited an equally wonderful variety of tints. Outside the harbor is a coral reef, and within this the water is of the pale green common to shallow ocean water; but outside it deepens very rapidly into the vivid blue of the open ocean. From a distance the line is clearly seen; but, as the observer approaches shore, the water changes from deep blue through every shade of blue and green until the pale green of the water within the harbor is reached.

As we approached land numbers of the queer outrigger canoes of the natives were met, and from the wharf boys jumped into the water and swam about the ship in the hope of persuading some of the passengers to throw over to them coins, which they are very skillful in diving for.

On the way to the hotel a few gardens were passed, and in them everything was strange. By far the most striking thing was the superb Poinciana regia. Although I had never seen this before I recognized it in an instant from a description of Charles Kingsley's, read long ago. Surely in the whole vegetable kingdom there is no more splendid plant. A spreading flat-topped tree, perhaps thirty feet high, with feathery green, acacia-like foliage and immense flat clusters of big

flaming scarlet flowers that almost completely hide the leaves so that the tree looks like an immense bouquet. They were in their prime about the time of my arrival in Honolulu and continued to flower more or less for the next six weeks. Pretty much everything in Honolulu, except the cocoanuts and an occasional haw tree (Paritium tiliaceum) is planted; but people seem to vie with each other in seeing how many different kinds of plants they can grow, and the result is that the place is like one great botanical garden. To Dr. Hillebrand this is said to be largely due, as he was one of the first to introduce foreign ornamental plants, and his place, which is kept much as it was at the time he left the islands, was a very remarkable collection of useful and ornamental plants from the warm regions of almost the whole globe.

Probably the first thing that strikes the traveler from the cooler regions is the great variety and number of palms. Of these the beautiful royal palm (Oreodoxa regia) is easily first. With its smooth columnar trunk, looking as if it had been turned, encircled with regular ring-shaped leaf-scars, and its crown of plumy green leaves, it well deserves its name. Other characteristic palms are various species of betel palms (Areca), wine palm, (Caryota), sugar palm (Arenga), and a great variety of fan-palms of different genera. None is more beautiful than a thrifty young cocoa palm, but unfortunately it is very subject in the Hawaiian islands to the ravages of some insect which eats the leaves and often renders them brown and unsightly. Indeed, it is almost impossible to find a specimen which is not more or less disfigured by this pest. The trunk of the cocoanut tree is usually more or less crooked, and in old specimens much too tall for its thickness, so that the old trees look top-heavy. The date palm flourishes in Honolulu, where it is quite dry, but does not do so well in the wetter parts of the islands.

On studying the other trees, one is struck at once by the great preponderance of Leguminosæ, especially Cæsalpineæ and Mimoseæ. All about the town, and growing very rapidly, is the algaroba (Prosopis juliflora), a very graceful tree of rapid growth, with fine bipinnate leaves and sweetish yellow pods, which animals are very fond of, and which are used extensively for fodder. Add to this that the tree now forms the principal supply of fuel for Honolulu and we can realize its full value. Other leguminous trees that are planted are

the monkey-pod (Pithecolobium samang), tamarind, various species of Bauhinia and Cathartocarpus. One species of the latter with great drooping bunches of golden yellow flowers and enormous cylindrical pods three or four feet long, rivals the Poinciana when in full flower.

Mingled with these are a great number of shrubs and trees with showy flowers or leaves, most of them more or less familiar to the stranger, either from pictures or from greenhouse specimens. Several species of Musa are grown, and when sheltered from the wind are most beautiful; but ordinarily the leaves are torn into rags by the wind. The tall and graceful M. sapientium has been largely supplanted by the much less beautiful Chinese banana, M. Cavendishii, which is short and stumpy in growth, but enormously prolific. The related traveler's tree (Ravenala Madagascariensis), is a common and striking feature of many Hawaiian gardens. Of the many showy flowering shrubs, the beautiful Hibiscus Rosa-Sinensis is one of the commonest, and is used extensively for hedges. One of the most striking hedges in the city, however, is the famous one at Puna Hou college, which is 500 feet long and composed of night-blooming cereus. I was not fortunate enough to see this when it was in full flower, but I saw a photograph of it when it was estimated that there were about 8,000 flowers at one time.

Of the fruit trees ordinarily grown, the following may be mentioned. The mango is a very handsome tree with dense dark green foliage and masses of yellow and reddish fruit on long hanging stalks. The bread-fruit tree is common, both cultivated and wild, and is a very beautiful tree of moderate size with leaves looking like immense fig-leaves, and the fruit like a large osage orange. I saw no ripe fruit, and so had not an opportunity of testing its quality. Guavas of different varieties are extremely common both wild and cultivated, and the various fruits of the whole citrus tribe grow well. The few specimens of temperate fruits were, for the most part, much inferior to those of the United States. Of the fruits that did not strike my fancy, at least at first, was the alligator pear (Persea gratissima), a big green or purple pear-shaped fruit with an immense single seed. The pulp is somewhat waxy in consistence and very oily. It is eaten as a salad, and very much relished by the islanders, but the taste is acquired. The curious papaya (Carica papaya) is another fruit which did not appeal to my palate. Its big orange fruit, not unlike a

melon in appearance when cut open, has a peculiar "squashy" flavor that suggested its having been kept a day too long.

Many showy climbers are planted, some of which, like Stephanotis, Thunbergia and Allamanda, are superb; but there is one that is particularly obnoxious in color, Bougainvillea, whose magenta floral-bracts are an offense to the eye, forming a cataract of raw color. It looks, as some one observed, as if it had just come from a chemical bath.

As soon as one gets fairly away from the city, it is at once seen that all the luxuriant vegetation is strange. Along the seashore is a plain gradually rising into low hills, both almost destitute of trees, except here and there a few cocoa palms along the shore. Of the strictly littoral plants among the most conspicuous is the curious Ipomœa pes-capræ, with deeply two-cleft leaves and purplish pink flowers. In the fertile lowlands near the sea are the principal cane and rice fields, which with taro are the staple crops. The rice is cultivated entirely by Chinese, near Honolulu; but on the sugar plantations the Japanese are largely employed. To see a Chinese laboriously transplanting little handfuls of rice into straight rows, or plowing in the mud and water with a primitive plow drawn by a queer Chinese buffalo are sights very foreign to an American eye. Sugar cane is eminently productive in the islands, and, hitherto, has proved the main source of revenue; but now the Hawaiians are bewailing the depression caused by the free admission of sugar from other countries into the United States; as, hitherto, their product has enjoyed practically a monopoly of the American market, having been admitted by treaty free of duty.

I made several trips up the valleys back of the city, but owing to the almost constant rain in many of them, these were not always agreeable. However, one is richly repaid by the luxuriance and variety of the vegetation. For a mile or two we pass between grass-covered hills, or hills overgrown in places with the lantana, which, introduced as an ornamental plant, has become a great pest. This plant covers some of the hills with an absolutely impassable thicket and spreads very rapidly, so that it is a serious problem what is to be done with it. Of the common roadside plants, an orange and yellow milk-weed and the showy white Argemone Mexicana were the most conspicuous. As one proceeds farther, where more moisture prevails, the variety becomes larger. Thickets of Canna and a Clerodendron with double rosy-white flowers,

are common, and the curious screw-pine (Pandanus odoratissimus) is occasionally seen. This latter is a very characteristic plant, but is much more abundant in some of the other islands. In this region several very showy species of Ipomœa are very common, among them the well-known moon-flower, I. bona-nox.

With the increase in moisture, as might be expected, the mosses and ferns increase in number and beauty. There are many of them of types quite different from those of the United States. One of the commonest ferns of the lower elevations is Microlepia tenuifolia, a very graceful fern with finely divided leaves and terminal sori. Species of Vittaria, with very long undivided leaves, are also common here.

As we ascend one of the commonest ferns is Sadleria cyatheoides, a very large fern, often more or less arborescent. Ascending still higher the number and variety of ferns increases rapidly, and many beautiful and interesting ferns and mosses and liverworts become common.

At about one thousand feet elevation we begin to meet with species of Cibotium, to which genus belong the largest of the tree ferns of the islands. Here, also, I met for the first time with the smallest of all the ferns I have ever seen, Trichomanes pusillum. This dainty little fern, one of the Hymenophyllaceæ, forms dense mats on rocks and tree-trunks, looking like a delicate moss. The full grown frond is fan-shaped and, with its stalk, is not more than half an inch high. These tiny leaves, nevertheless, in many cases bore sporangia.

With the increase in the amount of moisture, the epiphytic ferns become frequent. The principal ones we notice are species of Acrostichum, Polypodium, and, most conspicuous of all, the beautiful bird's-nest fern (Asplenium nidus), with immense bright green entire leaves. This superb plant is not at all uncommon in the forks of trees in the lower forest region.

Everywhere in this region are thickets of Freycinetia, sometimes even climbing the trees. This plant, looking very much like a Pandanus, is troublesome to get through, and often have we found ourselves walking on the tops of the bushes, three or four feet above the ground. As frequent tough convolvuli and ipomœas kept entangling our legs, progress was rather slow.

(*To be concluded.*)

Leland Stanford Junior University.

BRIEFER ARTICLES.

Carl Moritz Gottsche.—Carl Moritz Gottsche, who died Sept. 28th, at Altona, near Hamburg, was born there July 3, 1808. He has been a practicing physician in his native village for over a half century, and during an equal period, an ardent student of the Hepaticae, issuing a large number of publications thereon which vary from a few pages of critical notes to elaborate monographs. From his first serious publications in 1843–5[1] down to his work in recent years there cannot be said to be a single careless issue from his hand. In order to more satisfactorily illustrate his papers, he early learned the art of the engraver and his success in this direction can best be seen in his papers, especially in the matchless plates of his *Mexikanske Levermosser*.

His botanical interest commenced with the group he continued to study. In fact his contributions to other botanical fields are scarcely worth mentioning in comparison. His first papers were chiefly morphological and dealt on the one hand with that curious link between the thallose and foliose Hepaticæ, *Haplomitrium Hookeri*, and the equally curious but scarcely circumscribed marsupiocarpous Hepaticae which he called "Jungermanniae Geocalyceae." In 1844–1847 appeared the Synopsis Hepaticarum which was the combined work of Gottsche and two older men, Lindenberg and Nees von Esenbeck. Although the former had published a monograph of the European species as early as 1829[2] followed by the more elaborate one by the latter in 1833–38,[3] Gottsche's name appears first on the title page and it is evident that he did a large part of the work. This work contains descriptions of over 1600 species of Hepaticae and is the last summary of the group that has appeared, although the number of known species has more than doubled. He was further associated with Lindenberg in the publication of Species Hepaticarum (1839–51), an elaborate work attempting to illustrate all the known species, which for lack of support stopped short with the genera Plagiochila, Lepidozia and Mastigobryum [Bazzania]. In 1856 he became associated with Rabenhorst in issuing exsiccatæ of European Hepaticæ (Hepaticæ Europeæ) which extended to 66 decades (nos. 1–660), and which owe their chief value to Gottsche's elaborate notes and icones which appear on the labels to the specimens. It is unfortunate that the numbered specimens of this series were often carelessly put up and sometimes badly mixed; while

[1] Anatomisch-physiologische Untersuchungen über Haplomitrium Hookeri (1843). Ueber die Fructification der Jungermanniæ Geocalyceæ. (1845). Both papers were published in Acta Acad. Caes.-Leop.

[2] Synopsis Hepaticarum Europaearum. 4to. Bonn, 1829.

[3] Naturgeschichte der europäischen Lebermoose. 4 vols, 12°., Berlin and Breslau, 1833–38.

this was in no way the fault of Gottsche, it detracts from the value of his notes not to have with them, in each case, samples of the same plant on which the notes were made.

While we have not space here to mention all of Gottsche's work[4], we must call attention to two of his papers that are of special interest to Americans. The first is on the Hepaticæ of the U. S. of Columbia[5] and the second is on Hepaticæ of Mexico[6] and more especially bears on our own flora. Both are elaborate works, both are elegantly illustrated by Gottsche's own hand, in both the flora is very fully represented and the monographs constitute a broad and substantial beginning to any further study of the Hepaticæ of these lands. Unlike so many pioneer works, no time will have to be squandered over two or three line descriptions in order to ascertain what was most likely intended by the describer, for the descriptions are as carefully written as the drawings are elegantly engraved.

Dr. Gottsche leaves an extensive herbarium made all the more valuable by his elaborate sketches of the species which he invariably made in his study of any form. Better than all else he leaves a memory which extends over half a century of friendly help he has freely given to students of the Hepaticæ in all lands.—L. M. U.

An edible lichen not heretofore noted as such.—*Endocarpon miniatum* Schaer. has been collected by me in many states, and is abundant in Tennessee. It has also been sent to me from Japan and Cuba, two widely diverse localities. It inhabits calcareous rocks and may easily be mistaken for *Umbilicaria*, two species of which it resembles. I doubt if any writer has noticed or commended this lichen as an article of diet. But Mr. Minakata, who is a distinguished scholar and naturalist, and who has lately spent two years in the United States in study and travel, informs me that large quantities are collected in the mountains of Japan for culinary purposes, and largely exported to China as an article of luxury. He expresses surprise that no attention is paid to it here. The name by which it is known in Japan is *iwataka*, meaning "*stone-mushroom.*" Properly treated it resembles tripe.—W. W. Calkins, *Chicago, Ill.*

A new Tabebuia from Mexico and Central America: Tabebuia Donnell-Smithii n. sp., Plate xxvi.—A tree 50 to 75 feet high, often 4 feet in diameter: leaves palmately-compound on long peduncles 5 to 10

[4] As we are so soon to publish a full bibliography of the Hepaticæ, a complete list of Dr. Gottsche's writings will there be given.

[5] Hepaticæ in Triana et Planchon: Prodromus Floræ Novo-Granatensis. Ann. des Sc. Nat., 5th ser., i. 95–198, t. xvii–xx (1864).

[6] De Mexikanske Levermosser, efter Prof. Fr. Liebmann's Samling. Dansk. Vid. Salsk. Skrift. vi, 97–380, t. i–xx (1867).

C.E. Faxon, del.

TABEBUIA DONNELL-SMITHII, ROSE.

B. Meisel, Lith. Boston.

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inches long; leaflets 7, very variable in size (the largest on petiolues 1 to 3½ inches long), oblong to ovate, acuminate, rounded or truncate at base, serrate, glabrate in age, 2 to 10 inches long, often 3 inches broad: flowers arranged in a large terminal panicle of small cymes, 8 inches long, with short glandular-pubescence throughout: cymes few-flowered, with deciduous scarious bracts; pedicels 6 lines long: calyx closed in bud, deeply cleft and two-lipped in flower, 6 lines long: corolla yellow, tubular, 5-lobed; tube 1 to 1½ inches long; limb 1½ inches broad: stamens 4, included, didynamous; filaments incurved, glabrous except at base; anther cells glabrous, oblong; sterile filament 1½ lines long: ovary sessile: pods 12 inches or more long, 10-ribbed, glandular-pubescent and loculicidally dehiscent: seeds in 2 rows.—Common on the mountains about Colima and cultivated about the town. Collected by Capt. John Donnell Smith, at Cuyuta in the Department of Escuintla, at an alt. of 200 feet, April, 1890, no. 2070; and, also, by Dr. Edward Palmer, at Colima, Jan. 9 to Feb. 6, 1891, no. 1098.

This is said to be one of the most beautiful trees of Mexico, and is called "primavera." The flowers are a beautiful golden yellow produced in great abundance, and generally appearing before the leaves. The trees are often large, sometimes 4 feet in diameter and the wood very valuable. The trees are cut into logs about 12 feet in length, and shipped from Manzanillo in the state of Colima to the United States, principally to Cincinnati and San Francisco where they are used a great deal for cabinet work and veneering. The tree is very common in the lower part of the Department Escuintla; it is tall and slender, usually leafless, and with the profuse delicate yellow flowers standing out against the sky like golden clouds.

The following note is from a letter of J. D. Smith, Jan. 7, 1892: "The trees were too branchless for my servant to climb, too stout for him to fell with his machete, and too high for me to discern what manner of leaves were those which occasionally showed themselves among the flowers. My flowers were all picked up on the ground. I think there must be many trees in those countries, of which botanists have not been able easily to collect specimens, and which, therefore, remain unknown."

I have not been able to place in any known species this interesting tree. It seems curious that a tree so widely distributed, of such attractive flowers and of some commercial importance should have remained unknown to botanists. The species, while not agreeing in all respects with *Tabebuia*, answers better to this than to any other known genus. In its inflorescence and ribbed pods it is more like *Godmannia* or *Cybistax*, but does not agree in other particulars.—J. N. Rose, *Dep't of Agriculture, Washington, D. C.*

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The occasional cross.—When in 1876 I addressed the meeting of the American Association for the Advancement of Science at Detroit,[1] taking for my text what I then regarded as an extravagance, the exact language of a great teacher in science: "All plants with conspicuously colored flowers, or powerful odors, or honeyed secretions, are fertilized by insects; all with inconspicuous flowers, and especially such as have pendulous anthers, or incoherent pollen, are fertilized by the wind" I did not expect to see the proposition so widely modified as it is to-day. Our great leader, Asa Gray, wrote to me reiterating the strength of the position I was combating, and in the curt way quite allowable in the correspondence of friends whose regard for each other no difference of opinion could weaken, "dared" me to produce an instance of a flower as above characterized, that was not arranged for cross-fertilization. It was chiefly this "daring" that has led me in recent years to produce the instances. The broad view soon became modified so as to read that the plants were so arranged as to pollinate themselves in many instances when insects failed to do the work, and I doubt very much whether there is a prominent botanist to-day, who will deny that there are numerous instances in which sweet and colored flowers are so arranged that cross-fertilization is next to impossible. Indeed it has come to be quite frequent for authors on the relations between flowers and insects, when noting the contradictive facts to simply observe that an "occasional cross is not improbable."

It may not be useless at this stage of the progress of thought to inquire, what is the physiological value of an "occasional cross"?

No one familiar with nature can fail to see that, of the millions of seeds annually produced by plants, an almost imperceptible fraction only come to seed bearing individuals, and the seeds from the "occasional cross" can scarcely have any record in the progressive history of the race. Suppose we take Mr. Robertson's illustration of *Mollugo verticillata* (p. 274). I am satisfied that the "occasional cross" never occurs, and that "spontaneous self-pollination may take place" is putting the case with gratuitous mildness. A microscope would show that not only are the pollen-sacs disrupted and the pollen discharged over the pistil before the flower opens; but so long that the ovarium has commenced to assume the brown tint of ripeness, and the seeds, with full cotyledons, have reached their full size. But suppose this not to be the case, what chance has an "occasional cross" to get the resultant seeds into the reproductive stage again? I have before me a single plant of less than average size. It is one-sided, and extends over half a circle with a twelve inch radius. I find in one seed vessel just 30

[1] See Proc. Am. Ass. xxiv. p. 224.

seeds, and there have been already matured or on the road to maturity 372 seed vessels, with 11,160 seeds. How many of these would get through the long chapter of accidents and produce flowering plants next year? I venture to say not a hundred—possibly not ten. What chance has an "occasional cross" to benefit the race in a scheme like that proposed?

And then we find that those which get more than an "occasional cross" do not get along any better for it. Take Mr. Robertson's illustrations again. *Gaura biennis* I believe to be more dependent on insect aid than he himself has discovered, though none of those he names have any hand whatever in it, while its close ally *Gaura parviflora* is just as absolute a self fertilizer. And if *Œnothera fruticosa* is so arranged that self-pollination is impossible—a fact of which I am by no means sure—how about its neighbor *Œnothera biennis*, which is one of the closest self-fertilizers in the whole family, and yet has made its way not only all over the American continent, but has invaded the old world as well!

I repeat, where does the physiological advantage of the "occasional cross" come in?—THOMAS MEEHAN, *Germantown, Philadelphia.*

Sullivantia Hapemani.—In the November GAZETTE (p. 348), owing to undue haste in printing, this species appeared as a *Heuchera*. The oversight was unfortunate, but it is to be hoped that the correction can overtake the blunder. It is a matter of some interest to discover in our flora a third species of *Sullivantia*, and that, too, with range intermediate between that of the other two. *S. Ohionis* of the north central states (Ohio to Iowa and Minnesota) has always been considered a rare and interesting plant; and *S. Oregana* of the Willamette and Columbia Rivers still more so. This third species, from the Big Horn Mountains of Wyoming, well preserves the generic appearance, and would be recognized at a glance by those familiar with the other species, although much more closely related to its eastern congener, a thing to be expected. All three species affect the same situation; all being found growing in the crevices of dripping cliffs. In addition to the description in the November GAZETTE it may be added that the calyx-lobes are 3-nerved and bright green; the petals are obovate, entire, and brown at base; and the pod is broad and depressed at the partition. The species somewhat resembles *S. Ohionis*, but its lower habit, smaller and deeply cut leaves (the lobes acutely dentate), green and 3-nerved calyx-lobes, much broader obovate (not oblanceolate acutish) petals, and its broad and depressed pod make it very distinct.—JOHN M. COULTER, *Bloomington, Ind.*

EDITORIAL.

Those who are engaged in investigation cannot but regret the increasing tendency to the establishment by educational institutions of independent publications which are to contain the results of investigations conducted at the institution or by members of its staff. It is getting to be the fashion now for all the larger colleges and universities to undertake the issue of either occasional "bulletins," or "contributions," or "studies." The agricultural experiment stations have the issue of at least four bulletins in the course of the year forced upon them by an absurd law; but these newer publications are not stimulated by any thing except the desire of the institution to advertise itself. As soon as a college comes to have graduate students, and a faculty with the leisure and ability for original work, it feels that it must follow the example of other colleges, in order to let it be known that such work is in progress. There is no plea whatever that there is any necessity for the establishment of such publications except self-aggrandizement. It is not that worthy papers could not otherwise see the light; it is not that the regular journals and transactions of learned societies are unable or unwilling to care for the flood of manuscripts which might otherwise be poured upon them. Not that; it is solicitude on the part of the University of B——— lest the University of A——— should become greater in reputation, or should attract more students.

To one who is looking up the literature of any particular subject this multiplicity of irregular journals and bulletins and contributions and proceedings is simply maddening. In Germany this evil has become so great that almost every department of learning is compelled to have its *Jahresbericht* and *Centralblatt*, which have not only attempted to compass German but also all literature in their special fields. But the task is becoming herculean, and sooner or later subdivision either of territory or topic must be made. We are coming to a time, and that rapidly, when such indexes to American literature will be indispensable. Every new and especially every occasional publication adds to the difficulty of collecting or keeping informed of botanical literature. It was therefore with especial pleasure that we welcomed the beginnings of such indexing in the publications of the botanical division and the division of vegetable pathology at Washington.

The objection to the multiplication of publications is the stronger when it is seen that the benefit of advertising can be secured without the evil complained of. The plan long pursued by Drs. Gray and Watson of the Harvard Botanic Garden, and adopted by the Crypto-

gamic Laboratory of the same university, and by the Herbarium of Columbia College is warmly to be commended. The series of papers emanating from these places bears a uniform title and each paper its serial number and sub-title, of which the first article in this issue is an example. By this plan any institution which desires advertising can secure it and at the same time utilize the ordinary channels for obtaining publicity for its investigations.

Or the plan adopted by the Johns-Hopkins University in the publications of its "circulars," and the similar one lately put into operation by the University of Minnesota in its "Quarterly Bulletin" are even more to be commended. In these there appear abstracts of any papers published by students or members of the faculty, with references to the place of publication. They also give opportunity for the inclusion of accounts of university organization and work, and many items of interest to alumni and educators. They thus serve admirably to show what the institutions are doing, and as advertising media could not be improved; while at the same time, instead of adding to the scattered publications which must be kept track of, they actually help to direct the student to the literature he seeks.

By all means let the botanists of our larger institutions endeavor to prevent so far as possible the troublesome scattering of botanical papers.

CURRENT LITERATURE.

Western Grasses.

The "Grasses of the Southwest", lately completed, put into the hands of agrostologists 100 plates illustrating the chief species of the arid regions of the south western United States. It is quickly followed by part 1 of the "Grasses of the Pacific Slope",[1] in which fifty of the larger and economically important species are figured. The second part is expected to follow soon and when completed this will be the second volume of the"Illustrations of North American Grasses." Most of the species figured have not been illustrated before. The plates of this part are a decided improvement upon those of the second part of the first vo lume, even as these were better than the first. They are

[1] VASEY, GEORGE—Grasses of the Pacific Slope, including Alaska and the adjacent islands. Plates and descriptions of the grasses of California, Oregon, Washington and the northwestern coast including Alaska. Bulletin 13, Div. of Bot., Dep't of Agric. Issued Oct 20, 1892. Imp. 8° pl. 50. Washington. Gov't Printing Office.

lithographs by Meisel, who undoubtedly does the best work in this line of any man in the country.

The descriptions are drawn up mostly by Mr. L. H. Dewey, an assistant botanist of the division.

We have much commendation for the work, and but two adverse criticisms. It is a pity that a fuller synonymy is not given, with critical notes. The plates are valuable indeed; but their value would be much enhanced by such study, with in some cases more minute and thorough dissection of flowers. However if we cannot have a whole loaf we ought to give thanks for the half.

The second criticism relates to purely mechanical details. The plates of the second part of the first volume were nearly ruined by close trimming and these are cut too close also. Why not leave edges uncut, so that one trimming when bound would suffice? Such plates deserve a broad margin, rather than a "skimpy" one.

A new publication.

The botanical laboratory of the University of Pennsylvania begins a new serial entitled "Contributions from the botanical laboratory of the University of Pennsylvania."[1] Several similar publications having come to our attention recently, together with propositions for the establishment of others, we are moved to give expression to our views in the editorial pages on the general advisability of such issues by educational institutions.

This first number is admirably got up. The typography and paper is excellent and the plates are good.

The longest paper is by Dr. Macfarlane on Dionæa muscipula and is directed to a study of the irritability of the leaves. This is followed by a short paper on bud propagation in Dionæa, which Mr. Harshberger found to occur occasionally in the inflorescence. There are two papers by Dr. Wilson, one on the dioecism and proportion of staminate and pistillate flowers in Epigæa repens; the other (with the assistance of Mr. Greenman) on the movements of the leaves of Melilotus alba and other plants. In these researches Dr. Wilson finds that Melilotus and many other plants have a "hot sun" position for their leaves which is dependent largely upon the heat rays and the water supply, since it is intended to protect plants from excessive evaporation. Dr. Rothrock has two short notes, one on a monstrous form of Rudbeckia hirta, and the other on a nascent variety of Brunella vulgaris. Finally there is a chemical paper on mangrove bark tannin by Dr. Trimble, who finds this tannin quite similar to that in horse-chestnut, tormentil and rhatany.

[1] Philadelphia: Univ. of Pa. Press. 1892. vol. 1. no. 1. 8vo, pp. 73, pl. 13.

Minor notices.

THE SECOND BULLETIN of the U. S. Division of Vegetable Pathology[1] is devoted to a detailed preliminary report upon the California vine disease, which appeared in sufficient amount to attract attention in 1884 and 1885. Since then its spread has been rapid until 20,000 to 25,000 acres of vineyards in S. California have been devastated. The cause of the disease has not yet been discovered. This report gives an account of the incubation and spread of the disease; its characteristics and its relation to various supposed causes. It seems most nearly related to *rougeot* and *folletage*.

PROFESSOR L. H. PAMMEL has distributed copies of an elaborately illustrated lecture on the "Pollination of Flowers"[2] delivered at the January meeting of the Iowa Horticultural Society. The collation of useful illustrations (though these are wretchedly printed) and the most important literature bearing on this subject makes the pamphlet a very useful one to teachers. Two other short papers, "Cross and self-fertilization in plants" and "The effects of cross-fertilization in plants" are also included in the pamphlet.

OPEN LETTERS.

The Botanical Congress.

Since opinions are asked regarding an American Botanical Congress at Madison next year, I give mine briefly and categorically as follows:

1. By all means we must have a congress. Foreign botanists are expecting it, the time is ripe for it, and properly arranged, I believe that we will be able to secure a large and representative foreign delegation.

2. The success of the congress will depend *very largely* on the selection of a *live* general manager or secretary who will not be trammelled in his action by too much *a priori* machinery. He must be given power to act, if necessary, promptly *because* independently.

3. Action should be taken at once to secure a meeting of the International Committee on Nomenclature appointed at Genoa, in connection with next year's congress.

4. A program containing a *few* topics of general interest to botanists throughout the world should be announced at an early date. Now that nomenclature is practically settled, we are in a position to appreciate the fact that there are other matters of more importance, some of which may well be discussed in such a presence.

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[1] Washington: Gov. Printing Office: 1892. 8°. pp. 222. pl. xxv. chart 2.

[2] Apparently privately printed. pp. 57. figs 45.

5. The date should be pushed to the very last of August or the first week in September in order to accommodate European botanists whose university duties would prevent attendance earlier.

6. A free excursion of reasonable length (say as far as Lake Superior) ought to be arranged for; to this, arrangements should be added whereby foreign delegates could secure special rates to our great attractions in the far west should they care to make such extended excursions.—LUCIEN M. UNDERWOOD, *Greencastle, Ind.*

NEWS AND NOTES.

MR. W. H. NORRIS describes in the *American Naturalist* for August the development of the ovule of *Grindelia squarrosa.*

MR. D. T. MACDOUGAL is arranging a collecting trip to Mexico. He will start early in January. Those desiring plants from this region can address him regarding the matter at LaFayette, Ind.

A NEW EDITION of Koch's "Synopsis Floræ Germaniæ" is to be published under the editorship of Prof. P. Ascherson. The Prussian Academy of Sciences has voted him 2,000 marks to carry on the work.

THE BOTANICAL DEPARTMENT in the Bohemian University at Prague has been strengthened by the appointment of Dr. A. Hansgirg, until now lecturer in the same institution, and Dr. R. von Wettstein, of Vienna, to professorships.

MR. F. V. COVILLE gives an interesting account of the Panamint Indians of California (Am. Anthrop. v. 351), in which there is much of botanical interest. The question as to what these desert Indians can find in the way of vegetable food is answered by a surprisingly long list of plants whose seeds are chiefly used.

IN THE LAST number of *Hedwigia* (heft 4, 1892) Dr. C. Warnstorf describes five new species of Sphagnum: *S. Labradorense* of the ACUTIFOLIA, from Labrador; *S. dasyphyllum* of the CUSPIDATA from Connecticut; *S. Orlandense* from Florida; *S. Mohrianum* and *S. Mobilense* from Alabama, the three latter of the SUBSECUNDA.

M. HENRY DOULIOT, preparator at the Museum of Natural History at Paris, is dead at the age of 38, from a disease contracted during a scientific expedition. M. Douliot had already aquired a wide reputation through his researches in the histology of the higher plants. His work has been largely in conjunction with M. Van Tieghem.

IN THE November GAZETTE, (p. 341) we inadvertently omitted mention of the fact that the Department of Agriculture was the body that Dr. Vasey represented at Genoa, in addition to the Smithsonian Institute. It is but just that this correction should be made since the Department was the financial authority for the mission.—L. M. UNDERWOOD.

AMONG THE REPORTS of the large scientific staff at work on the Government Experiment Farms at Ottawa, Canada, for 1891, just issued as an appendix to the report of the Minister of Agriculture, is one from Mr. James Fletcher, the Botanist. It is concerned chiefly with reporting concerning experiments with grasses, some of which are figured, and describing some of the most prevalent and dangerous weeds that Canadian farmers will be likely to encounter.

THE TECHNIQUE of celloidin inbedding will be found set forth *in extenso* in two recent articles; one by W. Busse in *Zeitschrift für wissenschaftliche Mikroskopie* VIII. 462–475; and the other in a series entitled Mikrotechnische Mittheilungen, by Ludwig Koch, of which the first installment appears in Pringsheim's *Jahrbücher für wissenschaftliche Botanik*, XXIV. 1–51, under the caption "Ueber Einbettung, Einschluss und Färben pflanzlicher Objecte."

A LIST of Ohio Uredineæ and a brief account of wheat scab, by Miss Freda Detmers, together with a short description of Lactuca Scariola, by C. E. Thorne, make up bulletin 44 of the Ohio Experiment Station. The list of rusts contains about 68 species. The hosts and localities are given, and also a few additional notes. There is evidence of a lack of careful proof reading, and the cuts illustrating Lactuca and wheat scab are wretchedly printed.

AN IMPORTANT monograph of one of the much neglected groups of lower plants, the Oscillarieæ, appears in the *Annales des Sciences Naturelles* VII, XV, p. 263–368, with five plates. This, with the earlier monograph of the heterocystic Nostocaceæ by Bornet and Flahault, gives tolerably complete facilities for the determination of these plants. If some one would now put into compact form an account of our American species with analytic keys it would be serviceable.

DR. BYRON D. HALSTED is soon to issue a century of weed-seeds. The seeds will be in convenient vials, held in a tray which is about the size of an herbarium sheet. Suitable printed labels are also distributed. This collection is designed to assist station botanists in determining the foul stuff in commercial seeds, and also for the use of seedsmen; but all botanists should be interested. The price per set is $10, which is far below the real cost, and Dr. Halsted may be addressed at the N. J. Experiment Station, New Brunswick, N. J.

MR. ERNEST WALKER, of New Albany, Ind., has made some interesting observations on the scattering of seeds by the pods of *Oxalis stricta*. In the proper condition, the least disturbance will cause the seeds to be expelled with considerable force, and thrown two or three feet. Mr. Walker finds that the outer seed-coat is the agent in this dissemination, being a translucent shining membranous envelope stretched tightly over the seed, suddenly and elestically turning inside out when it bursts. Further details can be had from Proc. Philad. Acad., 1892, p. 288.

THREE DISEASES of tomatoes grown under glass are described by Prof. L. H. Bailey (Bull. no. 43), as observed at the Cornell Experiment Station. The most serious one, called winter blight, appears to be of a bacterial nature. Growth is checked, the leaves show ill-defined yellowish spots, later turning dark, the leaf curls and becomes stiff, the edges drawing downwards, giving the plant a wilted appear-

ance. Common blight (Cladosporium fulvum) and root-galls, caused by nematodes, are also described and illustrated. The results of various preventive measures are given.

In a contribution to the physiology of collenchyma (Prings. Jahrb. f. wiss. Bot. xxiv. 145) Jonas Cohn finds that this tissue normally contains in the cell wall from 60 to 70 per cent. by weight of water as against 20–40 per cent. in bast and wood. He holds that Bokorny's deductions as to the water-conducting function of collenchyma are founded on inexact experimentation and that C. Müller's idea that this is a water-storing tissue is likewise unsatisfactory. He was unable, however, to discover the relation between the mechanical peculiarities and the watery contents of collenchyma, and therefore does not suggest any theory as to its function.

Mr. H. J. Webber and Mr. W. T. Swingle are now at Eustis, Lake county, Florida, where a laboratory is being erected and fitted up for conducting experimental work on the anatomy, physiology and pathology of subtropical economic plants. The first important task is to learn something of Citrus fruits. Mr. Swingle has been working on the diseases of Citrus for the last two years. These observers are now starting at the base of matter in the orange blight investigation, and are just starting experiments on the transpiration of healthy and diseased plants, coupled with a histological investigation of the leaf and conducting tissue of healthy and diseased limbs.

The University of Illinois lately completed a new building for the departments of botany, zoology and geology which was formally dedicated as "Natural History Hall" on November 16th.

The exercises included addresses upon the development of the natural history departments, by Professor T. J. Burrill; science and the American college, by President David S. Jordan, of Leland Stanford University; the laboratory as a necessary part of the college equipment, by Professor William Trelease, Director of the Shaw School of Botany; and the methods of geology, by Professor N. H. Winchell, State Geologist of Minnesota. The botanical laboratories are said to be admirably arranged and adapted to the needs of instruction and investigation.

Mr. Elliott Coues gives a good illustration in a recent number of *Science* (xx, p. 219) of the proper meaning of the expression "once a synonym, always a synonym," which we reproduce in part. He says: "Let there be a genus *Smithia* in botany. Let a genus *Jonesia* then be named. Let *Jonesia* then be found to be the same genus as *Smithia*. Then the name *Jonesia* 'lapses into synonymy' and can not be thereafter applied *to any other genus* in botany. Exactly the same principle holds for all specific names within their respective genera. Example: Let there be a *Rosa Smithi*. Let some one then name a *Rosa Jonesi*. Let *R. Jonesi* be considered to be the same species as *R. Smithi*. Then there can never be a *R. Jonesi;* that is to say, *no other species* of *Rosa* can be specified as *R. Jonesi*. But, of course, if any one discovers, after this reduction of *Jonesi* to a synonym of *Smithi*, that what had been called *R. Jonesi* is a good species, then *Jonesi* revives as the name of *that* species; and the fact that it had been (erroneously) regarded as a synonym of *Smithi* is no bar to its use in its original sense."

GENERAL INDEX.

*** The more important classified entries will be found under the following heads: *Diseases*, *Floras*, *Journals*, *Personals*, *Reviews*.

*** Names of synonyms are printed in *Italics;* names of new species in **boldface;** † signifies death.

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